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Implementing TPM by doing Root Cause Analysis of the Downtime losses

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ABSTRACT: This research focuses on the study of contribution of Total Productive Maintenance (TPM) in the manufacturing firm in this competitive environment. This research is focusing in implementing Keikaku-Hozen (KH) Pillar activities for solving the breakdown problem in an industrial sector. The study is carried out in a Label Manufacturing industry which is now facing problem in establishing new printing Machines in their Plant, and also maintaining the machines to reduce the downtime, arising due to maintenance issues of the machines. The approach is directed in the direction for finding the root cause of the problem due to which maintenance problem rise in a manufacturing sector in Indian industries. The work includes solving the maintenance issue by doing root cause analysis (RCA) of the problem due to which downtime increases.Customization of TPM principles to project based industry is an important part of this research. The study focuses on the implementation of TPM for enhancing the performance of the printing machines and managing the maintenance issues arising during machining. By applying TPM and doing root cause analysis the maintenance issue is reduced by 50%.

KEYWORDS: Total Productive Maintenance (TPM), Keikaku-Hozen (KH),Root Cause Analysis (RCA), organisational performance.

I. INTRODUCTION

Maintenance activity that is productive and implemented by all employees is known as Total Productive Maintenance (TPM). TPM involves involvement of everyone in the organization including operators to senior management for the process of equipment improvement. TPM is now rapidly spreading through a wide range of manufacturing industries, such as steelmaking, chemical, foodstuffs, and cement industries. In fact, it has been introduced into virtually every line of business, with excellent results. In this way, TPM has expanded and developed into a truly company-wide activity. Total productive maintenance is a complete system used for maintaining equipment and also aims at achieving an optimal production environment devoid of defects, downtime, stoppages and accidents. One distinct advantage of total productive maintenance is that it empowers the shop floor to work in a concerted manner to ensure that machines are functioning at their optimal performance. This is because they all are proactively involved in the maintenance of machines which leads to increased productivity, lower costs improve quality and extended machine lifespan.

A. Summary Total Productive Maintenance Pillars

To successfully implement TPM, it is important to study the overall guidelines of all TPM activities. The eight pillars of TPM is a system for maximizing production effectiveness of any industry. The brief summary of eight pillars is given:

Table shows summary of TPM pillars

TPM Pillars	Description	Advantages
Autonomous Maintenance	Hands operators of equipment responsibility to carry out basic maintenance of equipment	Operators feel responsible for their machines, equipment becomes more reliable
.Planned Maintenance Keikaku-Hozen	Maintenance scheduled using the historic failure rate of equipment	Maintenance can be scheduled when production activities are few

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Quality	Quality ingrained in the equipment so as to reduce defects	Defect reduction & consequent profit improvement
Kobetsu Kaizen	Use of cross-functional teams for improvement activities	Improves problem solving capabilities of the workers
Early Equipment Maintenance	Design of new equipment using lesson learnt from previous TPM activities	New equipment achieves full potential in a shorter period of time
Education & Training	Bridging of the skills and knowledge gap through training of all workers	Employees gain the necessary skills to enable them solve problems within the organization
Health, Safety & Environment	Providing of an ideal working environment devoid of accidents and injuries	Elimination of harmful conditions & healthy workforce
TPM in the Office	Spread of the principles to administrative functions within an organization	Support functions understand the benefits of these improvements

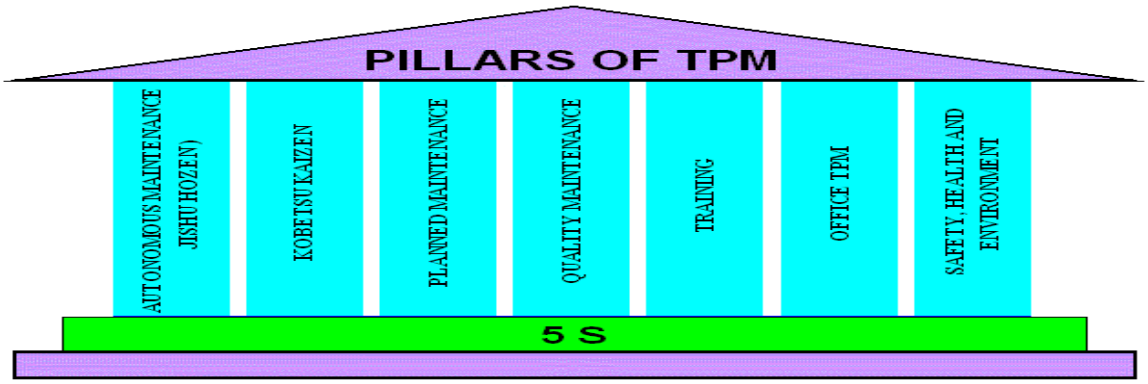

Figure showing the pillars of TPM

B. Keikaku-Hozen (KH)(PLANNED MAINTENANCE):

In planned maintenance it is aimed to have trouble free machines and equipment producing defect free products for total customer satisfaction. This breaks maintenance down into four "families" or groups.

1. Preventive Maintenance
2. Breakdown Maintenance
3. Corrective Maintenance
4. Maintenance Prevention

With Planned Maintenance we evolve our efforts from a reactive to a proactive method and use trained maintenance staff to help train the operators to better maintain their equipment.

C. Six steps in Planned maintenance:

1. Equipment evaluation and recoding present status.
2. Restore deterioration and improve weakness.
3. Building up information management system.
4. Prepare time based information system, select equipment, parts and members and map out plan.
5. Prepare predictive maintenance system by introducing equipment diagnostic techniques and

6. Evaluation of planned maintenance.

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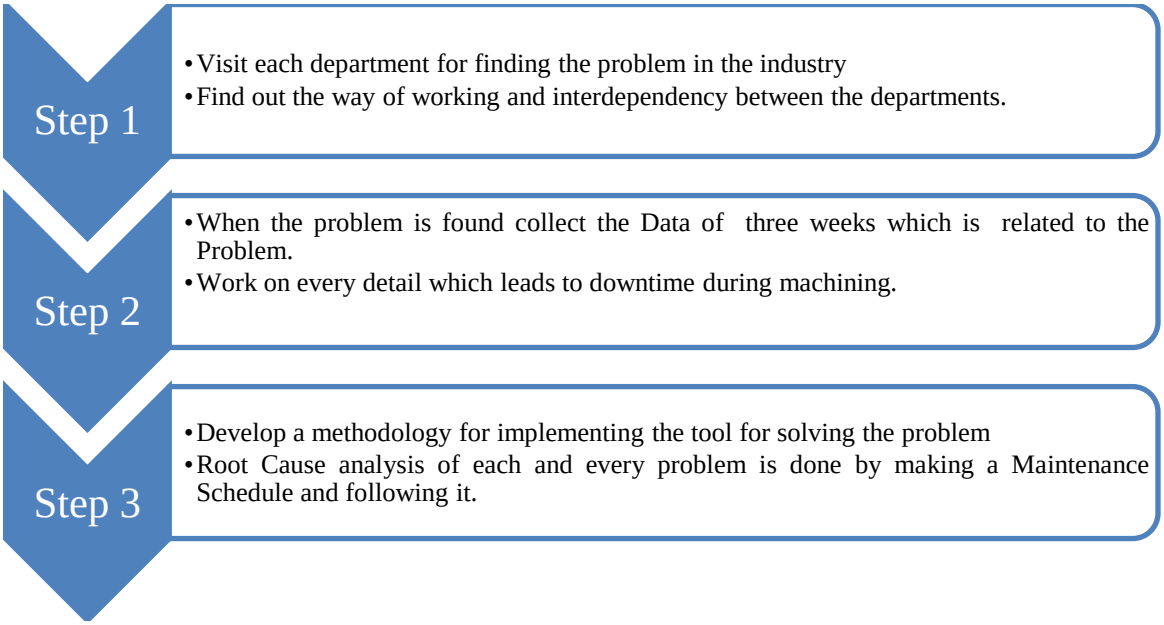
II. LITERATURE REVIEW

Prof. Ravi Ngaich, Pavan Kumar Malviya, (2015), evaluated the contributions of total productive maintenance (TPM) towards improving manufacturing performance in Small and Medium scale Enterprises. [1]
Abhishek Jain et al, (2014), had explained implementation practice to present an overview of TPM implementation practices adopted by various manufacturing organizations and suggest possible gaps from researchers and practitioner's point of view. [2]
V.R.Muruganantham et al, (2014), investigates the implementation and impact of TPM in isolation. [3]
Halim Mad Lazim et al, (2013), found the moderating effect of technical complexity in the production process on the relationship between TPM practices and manufacturing performance also significant relationships were found between TPM practices and cost [4]
Wasim.S.Hangad, Dr.Sanjay Kumar, (2013), explains TPM goals as to increase production while, at the same time, increasing employee morale and job satisfaction [5]
Ranteshwar Singh et al, (2013), says that all the pillars of TPM are implemented in a phased manner for eliminating the losses and thus improving the utilization of CNC machines [6]

III. CASE STUDY

Objective of case study is to find out Downtime Losses due to maintenance in a Label Manufacturing Industry, This case study is carried out in Skanem Interlabels Pvt Ltd which is global presence and expertise combined with Interlabels local knowledge, experience and coverage will make this Company a formidable force in the Indian label industry. By implementing TPM the Downtime loss due to maintenance is been reduced by 50%.

A. Methodology



B. Printing Machine:

- Gidue (M1 (M2);10 colour Flexo Printing Machine
- Gallus (M3); 9 Colour Printing Machine; Autoregister
- Gallus (M4);8 Colour Printing Machine; Autoregister

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Image of a Gallus Printing machine

- Nilpitter (M5); 12 Colour Machine; Auto Register; Foiling can be done.

Image of a nilpitter Printing Machine

- Opaque Machine (M6); 7 Colour Printing Machine; 6 Colour + 1 varnish;4 UV Lamp 2KB; 1 UV Lamp 4 KB (Down); 1 UV Lamp 7 KB on Central Impression Drum (CID)

C. Calculation and Result

Lamp is a very important source of a printing Machine. Without a lamp printing cannot be done in a proper way. Here readings of UV lamp of three weeks are shown.

- **U V Lamp reading**

Table showing UV Lamp reading (hours)

Machine no→	M1	M2	M3	M4	M5	M6
WEEK 1	96	74	01	21	48	42
WEEK 2	88	65	66	58	92	49
WEEK 3	89	18	48	56	55	96

Breakdown record is generally classified into Process down time and maintenance downtime.

- **Breakdown record for three weeks.**

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Process Down

Table showing process Down

M1	M2	M3	M4	M5	M6
Curing Problem	-	Compressor issue	-	-	Tripping of Lamp
Cassette Interchange	-	-	-	-	-
20 minutes	0 minutes	40 Minutes	0 minutes	0 minutes	30 minutes

Total process Down: 20+0+40+0+0+30=90 minutes

Maintenance Down

Table showing Maintenance Down

M1	M2	M3	M4	M5	M6
Lamp Failure	Reflector problem	Position of pressure roller	Shutter Problem	Hygienic Clearance	Over temperature
Nipple roller movement	-	-	-	-	-
90 minutes	25 minutes	20 minutes	35 minutes	10 minutes	50 minutes

Total Maintenance Down: 90+25+20+35+10+50=230 minutes

- **Total Breakdown time**

M1	M2	M3	M4	M5	M6
110	25	60	35	10	80

Total Breakdown Time: 110+25+60+35+10+80=320 minutes

For implementing TPM a weekly maintenance plan is been made and action plan is taken for the problems arising in the machining due to poor Maintenance plans

- **Maintenance Schedule Plan**

Table showing the maintenance schedule Plan

Machine	Week 1	Week 2	Week 3
M1	7/9/15	14/9/15	21/9/15
M2	7/9/15	15/9/15	22/9/15
M3	8/9/15	15/9/15	23/9/15
M4	9/9/15	16/9/15	23/9/15
M5	10/9/15	17/9/15	26/9/15
M6	10/9/15	19/9/15	26/9/15

- **Root Cause Analysis for reducing total down time**

Table showing the root cause analysis of downtime

Machine	Date	Down time(minutes)	Action Taken
M1			
Curing Problem	7/9/15	5	Lamp check
Cassette Interchange	7/9/15	15	Arrange properly
Lamp Failure	8/9/15	50	Lamp interchange
Nipple roller movement	9/9/15	40	Roller change
M2			
Reflector Problem	14/9/15	25	Reflector adjustment
M3			

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Compressor issue	12/9/15	40	Check the issue and solve it
Position of nipple roller	14/9/15	20	Adjust it according to the position of Pressure roller
M4			
Shutter Problem	26/9/15	35	Change the shutter
M5			
Hygienic Clearance	19/9/15	10	Pick the leftover Raw Material Carefully from the Machine Area
M6			
Tripping of Lamp	17/9/15	10	Check the alignment of the lamp and adjust it.
Lamp Change	17/9/15	20	Change the Lamp
Over temperature	10/9/15	50	Stop the work and adjust the compressor air supply.

After implementing TPM and solving the Problem the following results are obtained.

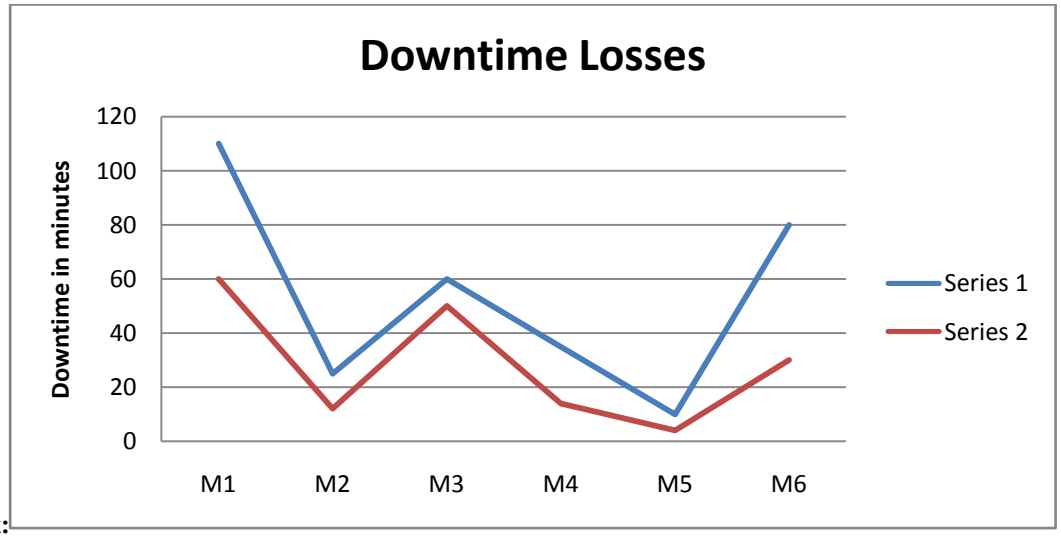
- **Objective:**

Table showing the final result after TPM Implementation

Machine no	Total Downtime(minutes)	% Reduction in breakdown	Target %	Remark
M1	60	45	50	Not achieved
M2	12	52	50	Achieved
M3	50	17	50	Not achieved
M4	14	60	50	Achieved
M5	4	60	50	Achieved
M6	30	62.5	50	Achieved

Total Breakdown time: 60+12+50+14+4+30=170 minutes

- **Result:**



Graph of Breakdown losses before and after implementation of TPM
-Series 1 shows downtime Loss before Implementing TPM
-Series 2 shows downtime Loss After Implementing TPM

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IV. CONCLUSION

After studying both of case study and literature review on TPM, I concluded that tools and techniques for eliminating wastes, helps manufacturers to improve the productivity of their enterprises. The manufacturing firms should develop their general plans and schedules according to the nature of their production to be able to reduce production costs.

Hence by implementing TPM the breakdown time during machining is reduced from 320 minutes to 170 minutes i.e., more than 50%. So the target of 50% reduction in downtime is achieved by the company by using TPM tool for finding root cause of the problem and taking corrective and Preventive action (CAPA) for the same.

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